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No. 200100250

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Pioneer Hi-Bred International, Inc.

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED DISTINCT VARIETY OF SEXUALLY REPRODUCED, OR TUBER PROPAGATED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF TWENTY YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, OR IMPORTING IT, OR EXPORTING IT, OR CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE , OR USING IT IN PRODUCING A HYBRID OR DIFFERENT VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. (84 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

CORN, FIELD

'PH581'

In Testimony Whereof, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of Washington, D.C. this twenty third day of May, in the year two thousand three.

PLANT VARIETY PROTECTION OFFICE

Attest:

Commissioner
Plant Variety Protection Office
Agricultural Marketing Service

Secretary of Agriculture

Robert Lee Segebart
App. No. 10/768,338

REF
A10

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY DIVISION - PLANT VARIETY PROTECTION OFFICE

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE

(Instructions and information collection burden statement on reverse)

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF OWNER
Pioneer Hi-Bred International, Inc.

2. TEMPORARY DESIGNATION OR EXPERIMENTAL NUMBER

3. VARIETY NAME
PH581

4. ADDRESS (Street and No. or RFD No., City, State and Zip Code, and Country)
7301 NW 62nd Avenue
P.O. Box 85
Johnston, IA 50131-0085

5. TELEPHONE (Include area code)
515/270-4051

6. FAX (Include area code)
515/253-2125

FOR OFFICIAL USE ONLY
PVPO NUMBER

FILING DATE
8/8/2001

7. IF THE OWNER NAMED IS NOT A "PERSON", GIVE FORM OF ORGANIZATION (corporation, partnership, association, etc.)
Corporation

8. IF INCORPORATED, GIVE STATE OF INCORPORATION)
IOWA

9. DATE OF INCORPORATON
March 5, 1999

10. NAME AND ADDRESS OF OWNER REPRESENTATIVE(S) TO SERVE IN THIS APPLICATION (FIRST PERSON LISTED WILL RECEIVE ALL PAPERS)
Steven R. Anderson
Research and Product Development
P.O. Box 85
Johnston, IA 50131-0085

FEES RECEIVED
FILING & EXAMINATION FEES: $ 2,705
DATE 8/8/01
CERTIFICATION FEE: $ 432.00
DATE 8/21/03

11. TELEPHONE (Include area code)
515/270-4051

12. FAX (Include area code)
515/253-2125

13. E_MAIL
Steven.Anderson@Pioneer.com

14. CROP KIND NAME (Common name)
CORN

15. GENUS AND SPECIES NAME OF CROP
Zea Mays

16. FAMILY NAME (Botanical)
Gramineae

17. IS THE VARIETY A FIRST GENERATION HYBRID?
☐ Yes ☒ No

18. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED (Follow instructions on reverse)
- a. ☒ Exhibit A. Origin and Breeding History of the Variety
- b. ☒ Exhibit B. Statement of Distinctness
- c. ☒ Exhibit C. Objective Description of the Variety
- d. ☐ Exhibit D. Additional Description of the Variety (Optional)
- e. ☒ Exhibit E. Statement of the Basis of the Owner's Ownership
- f. ☒ Voucher Sample (2500 viable untreated seeds or, for tuber propagated varieties verification that tissue culture will be deposited and maintained in an approved public repository)
- g. ☒ Filing and Examination Fee ($2,450), made payable to "Treasurer of the United States" (Mail to Plant Variety Protection Office))

19. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE SOLD AS A CLASS OF CERTIFIED SEED? See Section 83(a) of the Plant Variety Protection Act)
☐ YES (If "yes", answer items 20 and 21 below) ☒ NO (If "no", go to item 22)

20. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS?
☐ YES ☐ NO

21. IF "YES" TO ITEM 20, WHICH CLASSES OF PRODUCTION BEYOND BREEDER SEED?
☐ FOUNDATION ☐ REGISTERED ☐ CERTIFIED

22. HAS THE VARIETY (INCLUDING ANY HARVESTED MATERIAL) OR A HYBRID PRODUCED FROM THIS VARIETY BEEN SOLD, DISPOSED OF, TRANSFERRED, OR USED IN THE U.S. OR OTHER COUNTRIES?
☒ YES ☐ NO

IF YES, YOU MUST PROVIDE THE DATE OF FIRST SALE, DISPOSITION, TRANSFER, OR USE FOR EACH COUNTRY AND THE CIRCUMSTANCES. (Please use space indicated on reverse)

23. IS THE VARIETY OR ANY COMPONENT OF THE VARIETY PROTECTED BY INTELLECTUAL PROPERTY RIGHT (PLANT BREEDER'S RIGHT OR PATENT)?
☐ YES ☒ NO

IF YES, PLEASE GIVE COUNTRY, DATE OF FILING OR ISSUANCE AND ASSIGNED REFERENCE NUMBER. (Please use space indicated on reverse.)

24. The owner(s) declare that a viable sample of basic seed of the variety will be furnished with application and will be replenished upon request in accordance with such regulations as may be applicable, or for a tuber propagated variety a tissue culture will be deposited in a public repository and maintained for the duration of the certificate.

The undersigned owner(s) is(are) the owner of this sexually reproduced or tuber propagated plant variety, and believe(s) that the variety is new, distinct, uniform, and stable as required in Section 42, and is entitled to protection under the provisions of Section 42 of the Plant Variety Protection Act.

Owner(s) is(are) informed that false representation herein can jeopardize protection and results in penalties.

SIGNATURE OF OWNER		SIGNATURE OF OWNER	
		Steven R Anderson	
NAME (Please print or type)		NAME (Please print or type)	
		Steven R. Anderson	
CAPACITY OR TITLE	DATE	CAPACITY OR TITLE	DATE
		Research Scientist	8-01-01

S&T-470 (06-98)DESIGNED BY THE Plant Variety Protection Office with WordPerfect 6.0a. Replaces STO-470 (03-98) which is obsolete. *(See reverse for instructions and information collection burden statement)*

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INSTRUCTIONS

GENERAL: To be effectively filed with the Plant Variety protection Office (PVPO), ALL of the following items must be received in the PVPO: (1) Completed application form signed by the owner; (2) completed Exhibits A, B, C, E; (3) for a seed reproduced variety at least 2,500 viable untreated seeds, for a hybrid variety at least 2,500 untreated seeds of each line necessary to reproduce the variety, or for tuber reproduced varieties verification that a viable (in the sense that it will reproduce an entire plant) tissue culture will be deposited and maintained in a approved public repository; (4) check drawn on a U.S. bank for $2,450 ($30 filing fee and $2,150 examination fee), payable to "Treasurer of the United States" *(See Section 97.6 of the Regulations and Rules of Practice.)* Partial applications will be held in the PVPO for not more than 90 days, then returned to the applicant as unfiled. Mail application and other requirements to Plant Variety Protection Office, AMS, USDA, Room 500, NAL Building, 10301 Baltimore Avenue, Beltsville, MD 20705-2351. Retain one copy for your files. All items on the face of the application are self explanatory unless noted below. Corrections on the application form and exhibits must be initialed and dated. DO NOT use masking materials to make corrections. If a certificate is allowed, you will be requested to send a check payable to "Treasurer of the United States" in the amount of $320 for issuance of the certificate. Certificates will be issued to owner, not licensee or agent.

Plant Variety Protection Office
Telephone: (301)504-5518
FAX: (301)504-5291
Homepage: http://www.ams.usda.gov/science/pvp.htm

ITEM

18a. Give: (1) the genealogy, including public and commercial varieties, lines, or clones used, and the breeding method;
(2) the details of subsequent stages of selection and multiplication;
(3) evidence of uniformity and stability; and
(4) the type and frequency of variants during reproduction and multiplication and state how these variants may be identified.

18b. Give a summary of the variety's distinctness. Clearly state how this application variety may be distinguished from all other varieties in the same crop. If the new variety is most similar to one variety or a group of related varieties:
(1) identify these varieties and state all differences objectively;
(2) attach statistical data for characters expressed numerically and demonstrate that these are clear differences; and
(3) submit, if helpful, seed and plant specimens of photographs (prints) of seed and plant comparisons which clearly indicate distinctness.

18c. Exhibit C forms are available from the PVPO for most crops; specify crop kind. Fill in Exhibit C (Objective Description of Variety) form as completely as possible to describe your variety.

18d. Optional additional characteristics and/or photographs. Describe any additional characteristics that cannot be accurately conveyed in Exhibit C. Use comparative varieties as is necessary to reveal more accurately the characteristics that are difficult to describe, such as plant habit, plant disease resistance, etc.

18e. Section 52(5) of the Act required applicants to furnish a statement of the basis of the applicant's ownership. An Exhibit E form is available from the PVPO.

19. If "Yes" is specified *(seed of this variety be sold by variety name only, as a class of* certified seed), the applicant may NOT reverse this affirmative decision after the variety has been sold and so labeled, the decision published, or the certificate issued. However, if "No" has been specified, applicant may change the choice. *(See Regulations and Rules of Practice, Section 7.103).*

22. *See Sections 41, 42, and 43 of the Act and Section 97.5 of the regulations for eligibility requirements.*

23. See Section 5.5 of the Act for instructions on claiming the benefit of an earlier filing date.

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22. CONTINUED FROM FRONT (*Please provide the date of first sale, disposition, transfer, or use for each country and the circumstances, if the variety (including any harvested material) or a hybrid produced from this variety has been sold, disposed of, transferred, or used in the U.S. or other countries.*)

11/01/2000, United States and Canada

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23. CONTINUED FROM FRONT (*Please give the country, date of filing or issuance, and assigned reference number, if the variety or any component of the variety is protected by intellectual property right (Plant Breeder's Right or Patent).*

NOTES; It is the responsibility of the applicant/owner to keep the PVPO informed of any changes of address or change of ownership or assignment or owner's representative during the life of the application/certificate. There is no charge for filing a change of address. The fee for filing a change of ownership or assignment or any modification of owner's name is specified in Section 97.175 of the regulations. *(See Section 101 of the Act, and Sections 97.130, 97.131, 97.175(h) of Regulations and Rules of Practice.)*

To avoid conflict with other variety names in use, the applicant should check the variety names proposed by contacting: Seed Branch, AMS, USDA, Room 213, Building 306, Beltsville Agricultural Research Center–East, Beltsville, MD 20705. Telephone: (301) 504-8089.

S&T-470 (06-98DESIGNED BY THE Plant Variety Protection Office with WordPerfect 6.0a. Replaces STD-470 (03-96) which is obsolete. *(See reverse for instructions and information collection burden statement)*

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Exhibit A. Origin and Breeding History

Pedigree: PH06B/PHKW3)XW3-JH-152X

Pioneer Line PH581, *Zea mays L.*, a dent-like corn inbred, was developed by Pioneer Hi-Bred International, Inc. from the single cross hybrid PH06B X PHKW3 (PVP Certificate No. 9500209) using the pedigree method of plant breeding. Varieties PH06B and PHKW3 are proprietary inbred lines of Pioneer Hi-Bred International, Inc. Selfing was practiced from the above hybrid for 5 generations using pedigree selection. During line development, crosses were made to inbred testers for the purpose of estimating the line's combining ability. Yield trials were grown at Princeton, Illinois as well as other Pioneer research locations. After initial testing, additional hybrid combinations have been evaluated and subsequent generations of the line have been grown and hand-pollinated with observations again made for uniformity. Variety PH06B was derived from a 3-way hybrid MO17*PHN82 (Certificate No. 8900317) X PHR03 (Certificate No. 9100097).

Variety PH581 has shown uniformity and stability for all traits as described in Exhibit C - "Objective Description of Variety". It has been self-pollinated and ear-rowed 4 generations with careful attention paid to selection criteria and uniformity of plant type to assure genetic homozygousity and phenotypic stability. The line has been increased both by hand and in isolated fields with continued observations for uniformity and stability, and for 4 generations during the final stages of inbred development and seed multiplication. Very high standards for genetic purity have been established morphologically using field observations and electrophoretically using sound lab molecular marker methodology.

No variant traits have been observed or are expected in PH581.

The criteria used in the selection of PH581 were yield, both per se and in hybrid combinations; late season plant health, grain quality, stalk lodging resistance, and kernel size, especially important in production. Other selection criteria include: ability to germinate in adverse conditions; number of tillers, especially important in production because having numerous tillers increases hybrid production costs spent on detasseling; disease and insect resistance; pollen yield and tassel size.

Exhibit A: Developmental history for PH581

Season/Year Pedigree Grown	Inbreeding Level of Pedigree Grown
SEAS/YR: Spring 1994 PH06B PHKW3	F0
SEAS/YR: Summer 1994 PH06B/PHKW3	F1
SEAS/YR: Winter 1994 PH06B/PHKW3)X	F2
SEAS/YR: Winter 1994 PH06B/PHKW3)XW3	F3
SEAS/YR: Summer 1996 PH06B/PHKW3)XW3-JH-1	F4
SEAS/YR: Winter 1996 PH06B/PHKW3)XW3-JH-15	F5
SUMMER 1997 PH06B/PHKW3)XW3-JH-152	F6
Seed: PH06B/PHKW3)XW3-JH-152X	F7

*PH581 was selfed and ear-rowed from F3 through F6 generation.
#Uniformity and stability were established from F5 through F7 generation and beyond when seed supplies were increased.

Exhibit B. Novelty Statement

Variety PH581 mostly resembles Pioneer Hi-Bred International, Inc. proprietary inbred line PH12C (PVP Certificate No. 9800384). Data are compiled from 3 environments, two in the Johnston, IA area and one in the Ankeny, IA area. The data in Table 1A and 1B are from t-tests collected in 1999 and 2000.

Variety PH581 has a longer husk extension (9.0 cm vs 1.5 cm) than PH12C (Table 1A, 1B).

Variety PH581 has a longer husk length (24.9 cm vs 20.4 cm) than PH12C (Table 1A, 1B).

Variety PH581 has a shorter plant height (178.8 cm vs 222.0 cm) than PH12C (Table 1A, 1B).

Variety PH581 has a shorter tassel peduncle length (18.1 cm vs 25.8 cm) than PH12C (Table 1A, 1B).

Variety PH581 has fewer primary tassel branches (4.4 vs 9.8) than PH12C (Table 1A, 1B).

Exhibit B Novelty Statement Tables

Table 1A. Data from 1999 and 2000 are supporting evidence for differences between PH581 and PH12C. A t-test was performed and broken out by year.

TRAIT	year	variety-1	variety-2	Count-1	Count-2	Mean-1	Mean-2	Mean_Diff	StdDeviation-1	StdDeviation-2	StdError-1	StdError-2	DF_Pooled	t-Value_Pooled	Prob_(2-tail)_Pooled
husk extension length (cm)	1999	PH581	PH12C	15	15	8.1	1.4	6.7	1.387	1.242	0.358	0.321	28	13.9	0.000
husk extension length (cm)	2000	PH581	PH12C	15	15	9.9	1.6	8.3	1.668	1.121	0.431	0.289	28	16.1	0.000
husk length (cm)	1999	PH581	PH12C	15	15	24.8	20.6	4.2	1.014	1.242	0.262	0.321	28	10.1	0.000
husk length (cm)	2000	PH581	PH12C	15	15	24.9	20.2	4.7	1.387	1.014	0.358	0.262	28	10.7	0.000
plant height (cm)	1999	PH581	PH12C	15	15	168.7	212.7	-44.0	9.975	15.508	2.575	4.004	28	-9.2	0.000
plant height (cm)	2000	PH581	PH12C	15	15	188.9	231.3	-42.4	8.535	10.333	2.204	2.668	28	-12.3	0.000
tassel peduncle length (cm)	1999	PH581	PH12C	15	15	16.6	26.5	-9.9	2.131	1.846	0.550	0.477	28	-13.6	0.000
tassel peduncle length (cm)	2000	PH581	PH12C	15	15	19.6	25.2	-5.6	3.203	3.364	0.827	0.868	28	-4.7	0.000
tassel primary branch (# of primary branches)	1999	PH581	PH12C	15	15	4.4	8.9	-4.5	1.682	0.961	0.434	0.248	28	-9.1	0.000
tassel primary branch (# of primary branches)	2000	PH581	PH12C	15	15	4.4	10.7	-6.3	1.957	1.751	0.505	0.452	28	-9.3	0.000

Table 1B. Summary data across years are supporting evidence for differences between PH581 and PH12C. A t-test was performed across years.

TRAIT	variety-1	variety-2	Count-1	Count-2	Mean-1	Mean-2	Mean_Diff	StdDeviation-1	StdDeviation-2	StdError-1	StdError-2	DF_Pooled	t-Value_Pooled	Prob_(2-tail)_Pooled
husk extension length (cm)	PH581	PH12C	30	30	9.0	1.5	7.5	1.781	1.167	0.325	0.213	58	19.3	0.000
husk length (cm)	PH581	PH12C	30	30	24.9	20.4	4.5	1.196	1.133	0.218	0.207	58	14.9	0.000
plant height (cm)	PH581	PH12C	30	30	178.8	222.0	-43.2	13.712	16.015	2.504	2.924	58	-11.2	0.000
tassel peduncle length (cm)	PH581	PH12C	30	30	18.1	25.8	-7.7	3.078	2.743	0.562	0.501	58	-10.3	0.000
tassel primary branch (# of primary branches)	PH581	PH12C	30	30	4.4	9.8	-5.4	1.793	1.663	0.327	0.304	58	-12.2	0.000

DEFINITIONS

In the description and examples, a number of terms are used herein. In order to provide a clear and consistent understanding of the specification and claims, including the scope to be given such terms, the following definitions are provided:

ANT ROT = **ANTHRACNOSE STALK ROT** (*Colletotrichum graminicola*).
A 1 to 9 visual rating indicating the resistance to Anthracnose Stalk Rot. A higher score indicates a higher resistance.

BAR PLT = **BARREN PLANTS.**
The percent of plants per plot that were not barren (lack ears).

BRT STK = **BRITTLE STALKS.**
This is a measure of the stalk breakage near the time of pollination, and is an indication of whether a hybrid or inbred would snap or break near the time of flowering under severe winds. Data are presented as percentage of plants that did not snap.

BU ACR = **YIELD (BUSHELS/ACRE).**
Yield of the grain at harvest in bushels per acre adjusted to 15.5% moisture.

CLD TST = **COLD TEST.**
The percent of plants that germinate under cold test conditions.

CLN = **CORN LETHAL NECROSIS.**
Synergistic interaction of maize chlorotic mottle virus (MCMV) in combination with either maize dwarf mosaic virus (MDMV-A or MDMV-B) or wheat streak mosaic virus (WSMV). A 1 to 9 visual rating indicating the resistance to Corn Lethal Necrosis. A higher score indicates a higher resistance.

COM RST = **COMMON RUST** (*Puccinia sorghi*).
A 1 to 9 visual rating indicating the resistance to Common Rust. A higher score indicates a higher resistance.

DIP ERS = **DIPLODIA EAR MOLD SCORES** (*Diplodia maydis and Diplodia macrospora*).
A 1 to 9 visual rating indicating the resistance to Diplodia Ear Mold. A higher score indicates a higher resistance.

DRP EAR = **DROPPED EARS.**
A measure of the number of dropped ears per plot and represents the percentage of plants that did not drop ears prior to harvest.

EAR HT = **EAR HEIGHT.**
The ear height is a measure from the ground to the highest placed developed ear node attachment and is measured in cm.

EAR MLD = **GENERAL EAR MOLD.**
Visual rating (1-9 score) where a "1" is very susceptible and a "9" is very resistant. This is based on overall rating for ear mold of mature ears without determining the specific mold organism, and may not be predictive for a specific ear mold.

EAR SZ = **EAR SIZE.**
A 1 to 9 visual rating of ear size. The higher the rating the larger the ear size.

ECB 1LF = **EUROPEAN CORN BORER FIRST GENERATION LEAF FEEDING** (*Ostrinia nubilalis*).
A 1 to 9 visual rating indicating the resistance to preflowering leaf feeding by first generation European Corn Borer. A higher score indicates a higher resistance.

ECB 2IT = **EUROPEAN CORN BORER SECOND GENERATION INCHES OF TUNNELING** (*Ostrinia nubilalis*).
Average inches of tunneling per plant in the stalk.

ECB 2SC = **EUROPEAN CORN BORER SECOND GENERATION** (*Ostrinia nubilalis*).

A 1 to 9 visual rating indicating post flowering degree of stalk breakage and other evidence of feeding by European Corn Borer, Second Generation. A higher score indicates a higher resistance.

ECB DPE = **EUROPEAN CORN BORER DROPPED EARS** (*Ostrinia nubilalis*).
Dropped ears due to European Corn Borer. Percentage of plants that did not drop ears under second generation corn borer infestation.

EGRWTH = **EARLY GROWTH.**
This is the visual rating (1 to 9) of the amount of vegetative growth after emergence at the seedling stage (approximately five leaves). A higher score indicates better vigor or early season growth.

EST CNT = **EARLY STAND COUNT.**
This is a measure of the stand establishment in the spring and represents the number of plants that emerge on per plot basis for the inbred or hybrid.

EYE SPT = **EYE SPOT** (*Kabatiella zeae or Aureobasidium zeae*).
A 1 to 9 visual rating indicating the resistance to Eye Spot. A higher score indicates a higher resistance.

FUS ERS = **FUSARIUM EAR ROT SCORE.** (*Fusarium moniliforme or Fusarium subglutinans*).
A 1 to 9 visual rating indicating the resistance to Fusarium ear rot. A higher score indicates a higher resistance.

GDU = **GROWING DEGREE UNITS.**
Using the Barger Heat Unit Theory, which assumes that maize growth occurs in the temperature range 50°F - 86°F and that temperatures outside this range slow down growth; the maximum daily heat unit accumulation is 36 and the minimum daily heat unit accumulation is 0. The seasonal accumulation of GDU is a major factor in determining maturity zones.

GDU SHD = **GDU TO SHED.**
The number of growing degree units (GDUs) or heat units required for an inbred line or hybrid to have approximately 50 percent of the plants shedding pollen and is measured from the time of planting. Growing degree units are calculated by the Barger Method, where the heat units for a 24-hour period are:

$$GDU = \frac{(Max.\ Temp. + Min.\ temp.)}{} - 50/2$$

The highest maximum temperature used is 86° F. and the lowest minimum temperature used is 50°F. For each inbred or hybrid it takes a certain number of GDUs to reach various stages of plant development.

GDU SLK = **GDU TO SILK.**
The number of growing degree units required for an inbred line or hybrid to have approximately 50 percent of the plants with silk emergence from time of planting. Growing degree units are calculated by the Barger Method as given in GDU SHD definition.

GIBERS = **GIBBERELLA EAR ROT (PINK MOLD)** (*Gibberella zeae*).
A 1 to 9 visual rating indicating the resistance to Gibberella Ear Rot. A higher score indicates a higher resistance.

GLF SPT = **GRAY LEAF SPOT** (*Cercospora zeae-maydis*).
A 1 to 9 visual rating indicating the resistance to Gray Leaf Spot. A higher score indicates a higher resistance.

GOS WLT = **GOSS' WILT** (*Corynebacterium nebraskense*).
A 1 to 9 visual rating indicating the resistance to Goss' Wilt. A higher score indicates a higher resistance.

GRN APP = **GRAIN APPEARANCE.**
This is a 1 to 9 rating for the general appearance of the shelled grain as it is harvested based on such factors as the color of harvested grain, any mold on the grain, and any cracked grain. High scores indicate good grain quality.

HC BLT = **HELMINTHOSPORIUM CARBONUM LEAF BLIGHT** (*Helminthosporium carbonum*).
A 1 to 9 visual rating indicating the resistance to Helminthosporium infection. A higher score indicates a higher resistance.

HD SMT = **HEAD SMUT** (*Sphacelotheca reiliana*).
This score indicates the percentage of plants not infected.

KER KG = **KERNELS PER KILOGRAM.**
The number of kernels per 1 kilogram of seed after discard is removed.

KSZ DCD = **KERNEL SIZE DISCARD.**
The percent of discard seed; calculated as the sum of discarded tip kernels and extra large kernels.

MDM CPX = **MAIZE DWARF MOSAIC COMPLEX** (MDMV = Maize Dwarf Mosaic Virus and MCDV = Maize Chlorotic Dwarf Virus).
A 1 to 9 visual rating indicating the resistance to Maize Dwarf Mosaic Complex. A higher score indicates a higher resistance.

MST = **HARVEST MOISTURE.**
The moisture is the actual percentage moisture of the grain at harvest.

NLF BLT = **NORTHERN LEAF BLIGHT** (*Helminthosporium turcicum* or *Exserohilum turcicum*).
A 1 to 9 visual rating indicating the resistance to Northern Leaf Blight. A higher score indicates a higher resistance.

PLT HT = **PLANT HEIGHT.**
This is a measure of the height of the plant from the ground to the tip of the tassel in cm.

POL SC = **POLLEN SCORE.**
A 1 to 9 visual rating indicating the amount of pollen shed. The higher the score the more pollen shed.

POL WT = **POLLEN WEIGHT.**
This is calculated by dry weight of tassels collected as shedding commences minus dry weight from similar tassels harvested after shedding is complete.

PRM = **PREDICTED RELATIVE MATURITY.**
This trait, predicted relative maturity, is based on the harvest moisture of the grain. The relative maturity rating is based on a known set of checks and utilizes standard linear regression analyses and is also referred to as the Comparative Relative Maturity Rating System that is similar to the Minnesota Relative Maturity Rating System.

PRM SHD = **PREDICTED RELATIVE MATURITY GDU TO SHED.**
A relative measure of the growing degree units (GDU) required to reach 50% pollen shed. Relative values are predicted values from the linear regression of observed GDU's on relative maturity of commercial checks.

RT LDG = **ROOT LODGING.**
Root lodging is the percentage of plants that do not root lodge; plants that lean from the vertical axis at an approximately 30° angle or greater would be counted as root lodged.

SCT GRN = **SCATTER GRAIN.**
A 1 to 9 visual rating indicating the amount of scatter grain (lack of pollination or kernel abortion) on the ear. The higher the score the less scatter grain.

SEL IND = SELECTION INDEX.
The selection index gives a single measure of the hybrid's worth based on information for up to five traits. A maize breeder may utilize his or her own set of traits for the selection index. One of the traits that is almost always included is yield. When selection index data is presented, the tables represent the mean value averaged across testing stations.

SLF BLT = SOUTHERN LEAF BLIGHT (*Helminthosporium maydis* or *Bipolaris maydis*).
A 1 to 9 visual rating indicating the resistance to Southern Leaf Blight. A higher score indicates a higher resistance.

SOU RST = SOUTHERN RUST (*Puccinia polysora*).
A 1 to 9 visual rating indicating the resistance to Southern Rust. A higher score indicates a higher resistance.

STAGRN = STAYGREEN.
Staygreen is the measure of plant health near the time of black layer formation (physiological maturity). A high score indicates better late-season plant health.

STK CNT = NUMBER OF PLANTS.
This is the final stand or number of plants per plot.

STK LDG. = STALK LODGING.
This is the percentage of plants that did not stalk lodge (stalk breakage) as measured by either natural lodging or pushing the stalks and determining the percentage of plants that break below the ear.

STW WLT = STEWART'S WILT (*Erwinia stewartii*).
A 1 to 9 visual rating indicating the resistance to Stewart's Wilt. A higher score indicates a higher resistance.

TASBRN = TASSEL BRANCHES.
This is the number of primary tassel branches.

TAS SZ = TASSEL SIZE.
A 1 to 9 visual rating was used to indicate the relative size of the tassel. The higher the rating the larger the tassel.

TAS WT = TASSEL WEIGHT.
This is the average weight of a tassel (grams) just prior to pollen shed.

TEX EAR = EAR TEXTURE.
A 1 to 9 visual rating was used to indicate the relative hardness (smoothness of crown) of mature grain. A 1 would be very soft (extreme dent) while a 9 would be very hard (flinty or very smooth crown).

TILLER = TILLERS.
A count of the number of tillers per plot that could possibly shed pollen was taken. Data are given as a percentage of tillers: number of tillers per plot divided by number of plants per plot.

TST WT = TEST WEIGHT (UNADJUSTED).
The measure of the weight of the grain in pounds for a given volume (bushel).

YLD SC = YIELD SCORE.
A 1 to 9 visual rating was used to give a relative rating for yield based on plot ear piles. The higher the rating the greater visual yield appearance.

Exhibit C
(Corn Maize)

United States Department of Agriculture, Agricultural Marketing Service
Science Division, Plant Variety Protection Office
National Agricultural Library Building, Room 500
Beltsville, MD 20705

Objective Description of Variety
Corn (Zea mays L.)

Name of Applicant (s)	Variety Seed Source	Variety Name or Temporary Designation
Pioneer Hi-Bred International, Inc.		PH581
Address (Street & No., or RFD No., City, State, Zip Code and Country		FOR OFFICIAL USE
7301 NW 62nd Avenue, P.O. Box 85, **Johnston, Iowa 50131-0085**		PVP0 Number

Place the appropriate number that describes the varietal characters typical of this inbred variety in the spaces below. Right justify whole numbers by adding Leading zeroes if necessary. Completeness should be striven for to establish an adequate variety description. Traits designated by an '*' are considered Necessary for an adequate variety description and must be completed.

COLOR CHOICES (Use in conjunction with Munsell color code to describe all color choices: describe #25 and #26 in Comments section):

01=Light Green	06=Pale Yellow	11=Pink	16=Pale Purple	21=Buff
02=Medium Green	07=Yellow	12=Light Red	17=Purple	22=Tan
03=Dark Green	08=Yellow Orange	13=Cherry Red	18=Colorless	23=Brown
04=Very Dark Green	09=Salmon	14=Red	19=White	24=Bronze
05=Green-Yellow	10=Pink-Orange	15=Red & White	20=White Capped	25=Variegated (Describe)
				26=Other (Describe)

STANDARD INBRED CHOICES
(Use the most similar (in background and maturity) of these to make comparisons based on grow-out trial data):

Yellow Dent Families:

Family	Members
B14	CM105, A632, B64, B68
B37	B37, B76, H84
B73	N192, A679, B73, NC268
C103	Mo17, Va102, Va35, A682
Oh43	A619, MS71, H99, Va26
WF9	W64A, A554, A654, Pa91

Groups on Lynn/Osborn/Grunes/98-99PVP

Yellow Dent (Unrelated):
Co109, ND246, Oh7, T232, W117, W153R, W18BN

White Dent:
C166, H105, Ky228

Sweet Corn:
C13, Iowa5125, P39, 2132

Popcorn:
SG1533, 4722, HP301, HP7211

Pipecorn:
Mo15W, Mo16W, Mo24W

EXHIBIT C: PH581

1. TYPE: (describe intermediate types in Comments section):

2 1=Sweet 2=Dent 3=Flint 4=Flour 5=Pop 6=Ornamental

Standard Variety Name: H99

2. REGION WHERE DEVELOPED IN THE U.S.A.:

2 1=Northwest 2=Northcentral 3=Northeast 4=Southeast 5=Southcentral 6=Southwest 7=Other Central Corn Belt, W U.S.

Standard Seed Source: AMES 15931

3. MATURITY (In Region of Best Adaptability; show Heat Unit formula in 'Comments' section)

Application Variety Data DAYS	Application Variety Data HEAT UNITS		Standard Variety Data DAYS	Standard Variety Data HEAT UNITS
072	1,350.0	From emergence to 50% of plants in silk	070	1,295.8
072	1,354.3	From emergence to 50% of plants in pollen	072	1,334.5
003	0,075.0	From 10% to 90% pollen shed	003	0,083.5
		From 50% silk to optimum edible quality		
		From 50% silk to harvest at 25% moisture		

4. PLANT:

Application Variety Data		Standard Deviation	Sample Size	Standard Variety Data	Standard Deviation	Sample Size
178.8	cm Plant Height (to tassel tip)	13.57	06	152.2	17.34	06
054.7	cm Ear Height (to base of top ear node)	06.12	06	043.2	11.29	06
013.7	cm Length of Top Ear Internode	00.45	06	010.4	01.89	06
0.0	Average Number of Tillers	00.01	06	0.0	00.01	06
1.0	Average Number of Ears per Stalk	00.06	06	0.9	00.09	06
3	Anthocyanin of Brace Roots: 1=Absent 2=Faint 3=Moderate 4=Dark 5=Very Dark			2		

5. LEAF:

Application Variety Data		Standard Deviation	Sample Size	Standard Variety Data	Standard Deviation	Sample Size
09.7	cm Width of Ear Node Leaf	00.63	06	08.6	00.80	06
71.6	cm Length of Ear Node Leaf	01.82	06	68.7	05.27	06
06	Number of leaves above top ear	00.45	06	07	00.65	06
23	Degrees Leaf Angle (measure from 2nd leaf above ear at anthesis to stalk above leaf)	03.07	06	26	04.54	06
03	Leaf Color (Munsell code) 7.5GY3/4			03	5GY3/4	
1	Leaf Sheath Pubescence (Rate on scale from 1=none to 9=like peach fuzz)			1		
	Marginal Waves (Rate on scale from 1=none to 9=many)					
	Longitudinal Creases (Rate on scale from 1=none to 9=many)					

6. TASSEL:

Application Variety Data		Standard Deviation	Sample Size	Standard Variety Data	Standard Deviation	Sample Size
04	Number of Primary Lateral Branches	01.06	06	03	01.28	06
28	Branch Angle from Central Spike	13.73	06	27	05.12	06
53.3	cm Tassel Length (from top leaf collar to tassel tip)	02.26	06	41.5	01.62	06
5	Pollen Shed (rate on scale from 0=male sterile to 9=heavy shed)			4		
01	Anther Color (Munsell code) 2.5GY8/8			14	2.5R4/6	
01	Glume Color (Munsell code) 5GY6/6			01	5GY5/8	
1	Bar Glumes (Glume Bands): 1=Absent 2=Present			2		

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Application Variety Data PH581 Page 2 Standard Variety Data

7a. EAR (Unhusked Data):

11	Silk Color (3 days after emergence) (Munsell code)	10R66	07	2.5GY96
03	Fresh Husk Color (25 days after 50% silking) (Munsell code)	5GY58	01	5GY78
21	Dry Husk Color (65 days after 50% silking) (Munsell code)	5Y92	21	2.5Y84
1	Position of Ear at Dry Husk Stage: 1= Upright 2= Horizontal 3= Pendant		3	
7	Husk Tightness (Rate of Scale from 1=very loose to 9=very tight)		7	
3	Husk Extension (at harvest): 1=Short (ears exposed) 2=Medium (<8 cm) 3=Long (8-10 cm beyond ear tip) 4=Very Long (>10 cm)		2	

7b. EAR (Husked Ear Data):

		Standard Deviation	Sample Size		Standard Deviation	Sample Size
15.2	cm Ear Length	00.98	06	13.7	01.21	06
39.0	mm Ear Diameter at mid-point	01.10	06	34.8	01.33	06
096.2	gm Ear Weight	10.59	06	63.8	06.08	06
16	Number of Kernel Rows	00.52	06	11.7	00.52	06
2	Kernel Rows: 1=Indistinct 2=Distinct			2		
1	Row Alignment: 1=Straight 2=Slightly Curved 3=Spiral			1		
11.0	cm Shank Length	00.63	06	06.7	01.51	06
2	Ear Taper: 1=Slight 2= Average 3=Extreme			2		

8. KERNEL (Dried)

		Standard Deviation	Sample Size		Standard Deviation	Sample Size
10.2	mm Kernel Length	00.41	06	08.8	00.75	06
08.0	mm Kernel Width	00.63	06	08.2	00.41	06
05.0	mm Kernel Thickness	00.00	06	05.0	00.00	06
51.5	% Round Kernels (Shape Grade)	05.05	06	58.3	13.25	06
1	Aleurone Color Pattern: 1-Homozygous 2=Segregating			1		
07	Aluerone Color (Munsell code)	10YR712		07	10YR814	
07	Hard Endosperm Color (Munsell code)	10YR610		07	2.5Y812	
03	Endosperm Type:			3		
	1=Sweet (Su1) 2=Extra Sweet (sh2) 3=Normal Starch 4=High Amylose Starch 5=Waxy Starch 6=High Protein 7=High Lysine 8=Super Sweet (se) 9=High Oil 10=Other___					
24.5	gm Weight per 100 Kernels (unsized sample)	02.17	06	25.83	02.64	06

9. COB:

		Standard Deviation	Sample Size		Standard Deviation	Sample Size
23.3	mm Cob Diameter at mid-point	00.52	06	21.3	01.21	06
19	Cob Color (Munsell code) 5Y91			19	2.5Y92	

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10. DISEASE RESISTANCE (Rate from 1 (most susceptible) to 9 (most resistant); leave blank if not tested; leave Race or Strain Options blank if polygenic):

Application Variety Data		Standard Variety Data
	A. Leaf Blights, Wilts, and Local Infection Diseases	
	Anthracnose Leaf Blight (Colletotrichum graminicola)	
5	Common Rust (Puccinia sorghi)	6
	Common Smut (Ustilago maydis)	
	Eyespot (Kabatiella zeae)	
	Goss's Wilt (Clavibacter michiganense spp. nebraskense)	
5	Gray Leaf Spot (Cercospora zeae-maydis)	2
	Helminthosporium Leaf Spot (Bipolaris zeicola) Race ——	
3	Northern Leaf Blight (Exserohilum turcicum) Race ——	6
	Southern Leaf Blight (Bipolaris maydis) Race ——	
	Southern Rust (Puccinia polyscra)	
6	Stewart's Wilt (Erwinia stewartii)	6
	Other (Specify) ——	
	B. Systemic Diseases	
	Corn Lethal Necrosis (MCMV and MDMV)	
9	Head Smut (Sphacelotheca reiliana)	9
	Maize Chlorotic Dwarf Virus (MDV)	
	Maize Chlorotic Mottle Virus (MCMV)	
	Maize Dwarf Mosaic Virus (MDMV)	
	Sorghum Downy Mildew of Corn (Peronosclerospora sorghi)	
	Other (Specify) ——	
	C. Stalk Rots	
1	Anthracnose Stalk Rot (Colletotrichum graminicola)	1
	Diplodia Stalk Rot (Stenocarpella maydis)	
	Fusarium Stalk Rot (Fusarium moniliforme)	
	Gibberella Stalk Rot (Gibberella zeae)	
	Other (Specify) ——	
	D. Ear and Kernel Rots	
	Aspergillus Ear and Kernel Rot (Aspergillus flavus)	
5	Diplodia Ear Rot (Stenocarpella maydis)	2
7	Fusarium Ear and Kernel Rot (Fusarium moniliforme)	6
	Gibberella Ear Rot (Gibberella zeae)	
	Other (Specify) ——	

11. INSECT RESISTANCE (Rate from 1 (most susceptible) to 9 (most resistant); (leave blank if not tested) :

	Banks grass Mite (Oligonychus pratensis)	
	Corn Worm (Helicoverpa zea)	
	Leaf Feeding	
	Silk Feeding	
	mg larval wt.	
	Ear Damage	
	Corn Leaf Aphid (Rhopalosiphum maidis)	
	Corn Sap Beetle (Carpophilus dimidiatus	
	European Corn Borer (Ostrinia nubilalis)	
6	1st Generation (Typically Whorl Leaf Feeding)	7
3	2nd Generation (Typically Leaf Sheath-Collar Feeding)	2
	Stalk Tunneling	
	cm tunneled/plant	
	Fall Armyworm (Spodoptera frugiperda)	
	Leaf Feeding	
	Silk Feeding	
	mg larval wt.	
	Maize Weevil (Sitophilus zeamaize	
	Northern Rootworm (Diabrotica barberi)	
	Southern Rootworm (Diabrotica undecimpunctata)	
	Southwestern Corn Borer (Diatreaea grandiosella)	
	Leaf Feeding	
	Stalk Tunneling	
	cm tunneled/plant	
	Two-spotted Spider Mite (Tetranychus urticae)	
	Western Rootworm (Diabrotica virgifrea virgifera)	
	Other (Specify) ——	

12. AGRONOMIC TRAITS:

5	Staygreen (at 65 days after anthesis) (Rate on a scale from 1=worst to excellent)	2
	% Dropped Ears (at 65 days after anthesis)	
	% Pre-anthesis Brittle Snapping	
	% Pre-anthesis Root Lodging	
14.3	Post-anthesis Root Lodging (at 65 days after anthesis)	7.2
4,930.0	Kg/ha Yield of Inbred Per Se (at 12-13% grain moisture)	1,700.0

13. MOLECULAR MARKERS: (0=data unavailable; 1=data available but not supplied; 2=data supplied):

1 Isozymes 0 RFLP's 0 RAPD's

COMMENTS (eg. state how heat units were calculated, standard inbred seed source, and/or where data was collected. Continue in Exhibit D):

CLARIFICATION OF DATA IN EXHIBITS B AND C

Please note the data presented in Exhibit C, "Objective Description of Variety," are collected primarily at Johnston and Ankeny, Iowa. The data in Exhibit B are from comparisons of inbreds grown in the same tests in the adapted growing area of PH581 and in Johnston and Ankeny, IA. The data in Tables 1A and 1B are from paired comparison t-tests collected in Johnston and Ankeny, IA. These traits collectively show distinct differences between the two varieties.

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The data collected in exhibit C was collected in 1999 and 2000 for page 1 and 2. There were 3 different planting dates planted each year for these trials. There are environmental factors that differ from year to year and planting date to planting date. Environmental temperature and precipitation differences during the vegetative and grain fill periods can impact plant and grain traits, and are a source of variability. The environmental conditions described above could result in larger standard deviations. The variation associated with year to year and environment to environment is normally higher than the variation associated within locations. I have enclosed a table that should show some of the temperature and precipitation differences between 1999 and 2000. Please enclose this table as part of Exhibit D

Exhibit D. Temperature and Precipitation differences from Ankeny, IA

TEMPERATURE

YEAR	MAY	JUN	JULY	AUG	AVERAGE
1994	59.8	70.7	71.9	69.0	67.9
1995	56.2	69.4	74.3	76.9	69.2
1996	56.2	69.3	71.3	70.5	66.8
1997	53.5	70.6	74.1	69.6	67.0
1998	64.7	66.6	74.8	73.5	69.9
1999	60.7	69.7	78.7	70.5	69.9
2000	63.5	68.9	73.2	74.2	70.0

RAINFALL

YEAR	MAY	JUN	JULY	AUG	Total
1994	3.67	5.75	1.71	4.18	15.31
1995	5.04	4.19	2.94	2.87	15.04
1996	8.47	4.35	2.51	2.14	17.47
1997	4.32	3.27	4.10	1.36	13.05
1998	6.46	11.07	5.70	4.96	28.19
1999	6.46	4.54	4.45	6.55	21.85
2000	5.40	5.80	3.16	1.78	16.14

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

EXHIBIT E
STATEMENT OF THE BASIS OF OWNERSHIP

The following statements are made in accordance with the Privacy Act of 1974 (5 U. S. C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF APPLICANT(S)

PIONEER HI-BRED INTERNATIONAL, INC.

2. TEMPORARY DESIGNATION OR EXPERIMENTAL NUMBER

3. VARIETY NAME

PH581

4. ADDRESS *(Street and No., or R.F.D. No., City, State, and ZIP, and Country)*

7301 NW 62nd AVENUE
P.O.BOX 85
JOHNSTON, IA 50131-0085

5. TELEPHONE *(include area code)*

515-270-4051

6. FAX *(include area code)*

515-253-2125

7. PVPO NUMBER

8. Does the applicant own all rights to the variety? *Mark an "X" in appropriate block. If no, please explain:* ☒ YES ☐ NO

9. Is the applicant (individual or company) a U.S. national or U.S. based company? ☒ YES ☐ NO

If no, give name of country

10. Is the applicant the original owner? ☒ YES ☐ NO *If no, please answer one of the following:*

a. If original rights to variety were owned by individual(s), is(are) the original owner(s) a U.S. national(s)?

☐ YES ☐ NO *If no, give name of country*

b. If original rights to variety were owned by a company(ies), is(are) the original owner(s) a U.S. based company?

☒ YES ☐ NO *If no, give name of country*

11. Additional explanation on ownership *(if needed, use reverse for extra space)*:

PH581 is owned by Pioneer Hi-Bred International, Inc.

PLEASE NOTE:

Plant variety protection can be afforded only to owners (not licensees) who meet one of the following criteria:

1. If the rights to the variety are owned by the original breeder, that person must be a U.S. national, national of a UPOV member country, or national of a country which affords similar protection to nationals of the U.S. for the same genus and species.
2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by national of a country which affords similar protection to nationals of the U.S. for the same genus and species.
3. If the applicant is an owner who is not the original owner, both the original owner and the applicant must meet one of the above criteria.

The original breeder/owner may be the individual or company who directed final breeding. See section 41(a)(2) of the Plant Variety Protection Act for definition.

STD-470-E (07-97) *(Destroy previous editions).*
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